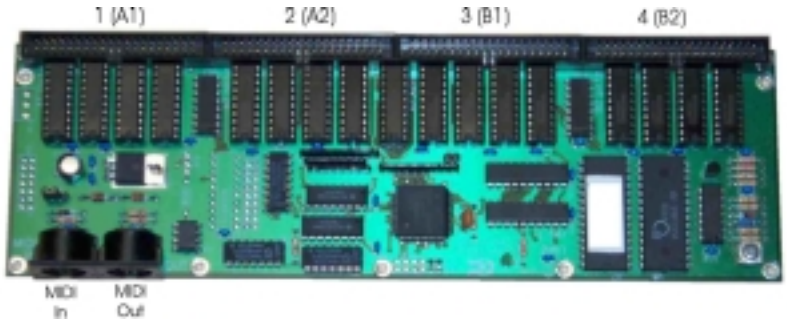
MIDIATOR™ Systems

# UM0 User's Manual




June 2002

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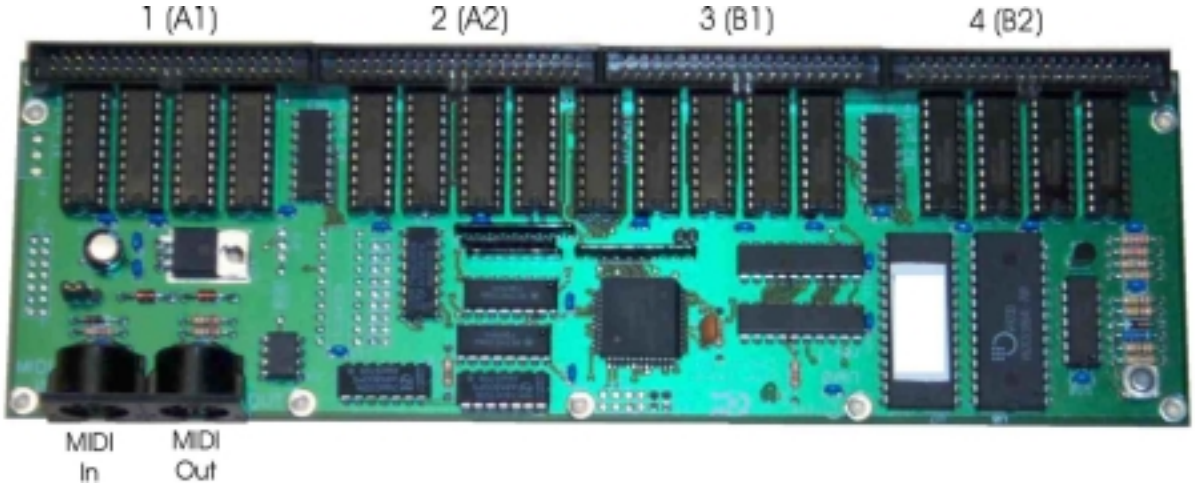
# Installation summary



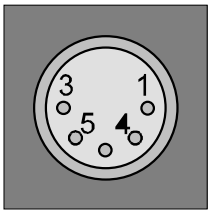

View of the top of UM0.

## 1) Select Mode and Channel

Because the UM0 does not have a mode or channel selector switch, it must be configured with the *UM0 setup/diagnostics software* (see page 7).

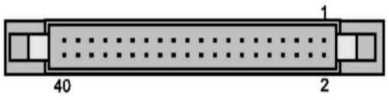
## 2) Connect MIDI

(see page 10 for MIDI connector pinout)




You must connect MIDI IN to your source (i.e. MIDI OUT of computer, synthesizer, or UM1).

## 3) Connect Outputs




Connect your outputs to the 40-pin headers on the UM0 (see page 11 for pinout); optionally use our screw terminal adaptors (see page 5).

## 4) Connect Power supply

The UM0 requires 7 to 25 volts power supply; this is usually tapped from the main supply of your system. The negative of the power supply connects to the NEG pins of the 40-pin headers in the back of the UM0 (see page 11 for pinout); in most cases this is also ground of the system. As an output device, the UM0 switches its outputs to NEG (it's the return path); we recommend that all NEG pins connect to the power supply negative.
The positive of the power supply (7-25 volts) connects to the POS pins of the 40-pin headers in the back of the UM0 (see page 11 for pinout); usually, this is also the common to all the relays or switches in the system. One connection to POS is required, the others are optional.

# Introduction

The UM0 receives MIDI messages and activates its outputs accordingly. The outputs can be used to drive organ pipe relays, lamps and other accessories.

The UM0 has two internal partitions. Each partition can be used independently as 64 outputs; the two partitions can be combined into a single 128 output partition.

# Installation

In the following sections, the examples show organ manuals (keyboards) and organ pipes (with relays) connected to UM0s. These are just the most common items used with the UM0; here are a few examples of what the UM0 can control:

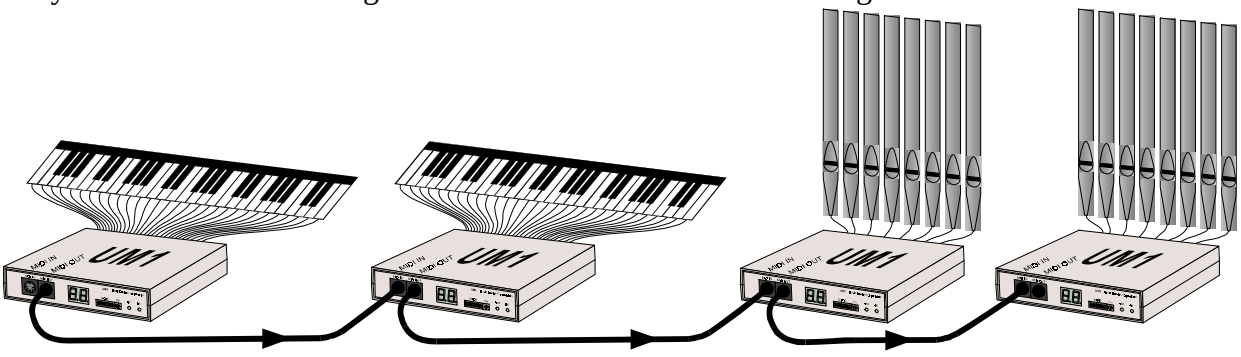
- Other musical instruments such as trumpets, xylophone, bells, drums, etc…
- Electric lights, with or without relays, depending on voltage/power
- Garage doors, alarm systems, model trains…
- Other control applications involving a computer

## Requirements

Power: the UM0 requires power from an external source; this is usually tapped from the main supply of your system. The voltage must be between 7 and 25 volts. The current used by the UM0 is less than 0.2 amps.
MIDI: the UM0 receives or generates MIDI, so it must be connected to a MIDI device; a computer, synthesizer…
Computer: For diagnostics and software setup, a PC with Windows 95 or Windows 3.1 and a MIDI port is required.

## Stand-alone configuration

The simplest system is the stand-alone configuration. In the following diagram, two UM1s are connected to manuals (keyboards), generating MIDI note messages from keys. Each UM1 is assigned a different MIDI channel. Two UM1s are receiving the MIDI notes, driving the pipe relays. Those UM0s are assigned the same channels as the encoding UM1s.

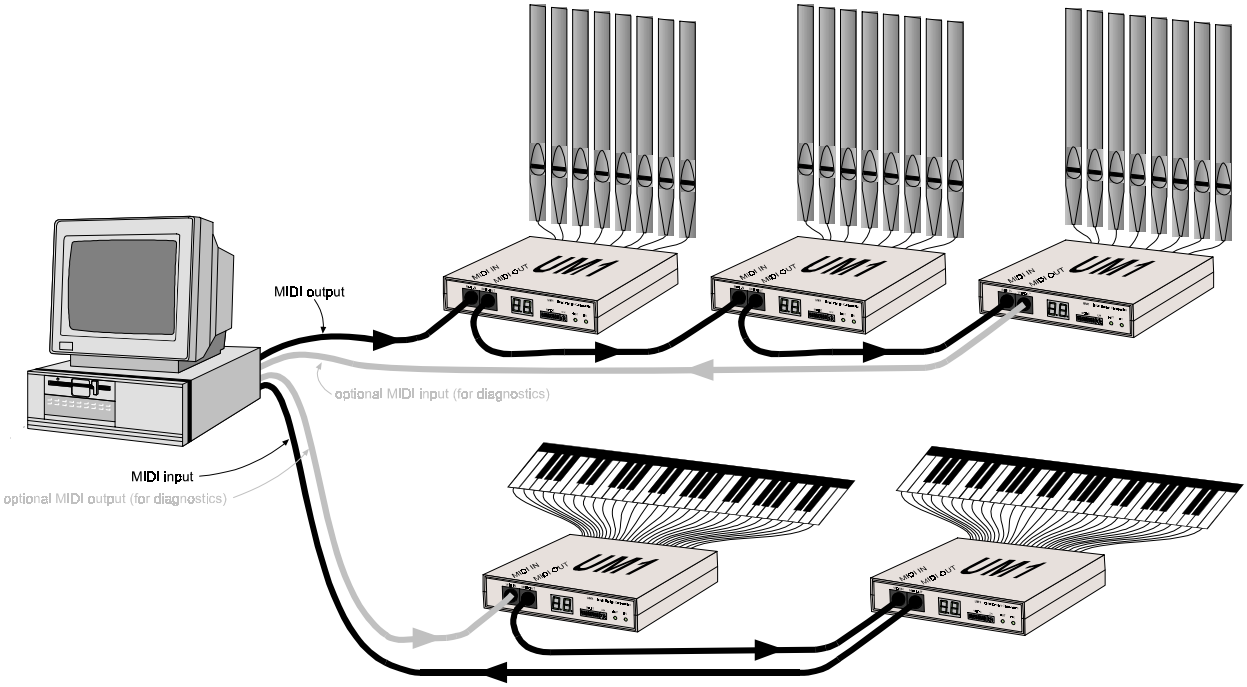


The limitation of this system is the one-to-one correspondence between keys pressed and pipes playing. Most organs need to be able to play multiple pipes for one key pressed.

Another stand-alone example is the addition of ranks of pipes to a synthesizer system; those ranks would be equipped with relays and UM1s, connected to the MIDI OUT of the synthesizer. The pipes would play when the player sets the synthesizer's output channel to the UM1's MIDI channels.

## Computer controlled configuration

This is the most powerful and flexible installation. All the MIDI note messages generated from the keyboards go through the computer before they control the relay drivers.



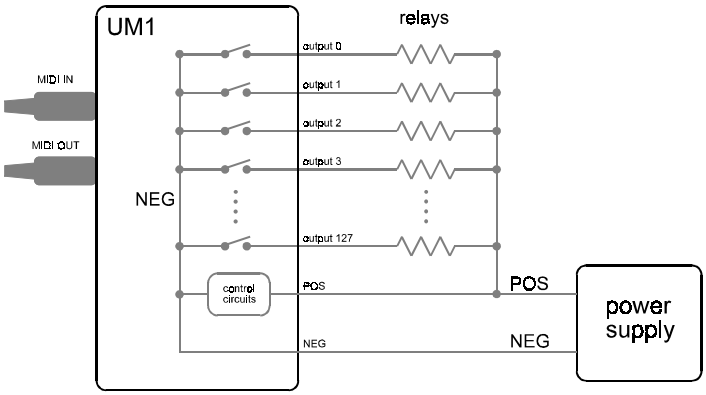

This system allows recording and playback with sequencing software. Also, with the appropriate software each note message can be dynamically multiplied to activate several pipes in several ranks (implementing organ stops).

Up to 16 UM0s can be daisy chained on a single MIDI cable. In practice, we keep this number lower, because of the MIDI delay: every note message takes about one millisecond (0.001 sec) to be transmitted on the cable. This is not a problem on the console side, a single MIDI cable can keep up with ten fingers and two feet. But on the pipes side, if one key, for example, could activate 10 pipes, 5 keys pressed simultaneously can cause a delay of 0.050 sec, which is noticeable. If this applies to your system, you should have multiple MIDI output ports on your computer (we suggest 2 to 8 ranks of pipes per MIDI port, depending on the flow).

## Setup of UM0 as relay driver

The function of the UM0 is to receive MIDI note messages and drive its outputs accordingly. The UM0 must be in output mode, according to the software setup (see page 7).

The outputs are connected to relays, solenoids, valves, lights or other resistive/inductive loads (see specification page 8 for maximum load). The UM0 outputs are active low, which means they act like a switch to the negative of the power supply (see diagram below); therefore the relays are connected between the UM0 outputs and the positive of the power supply.




The positive of the power supply must also connect to "POS", pin 1 of the 40-pin connectors (see chart page 11).

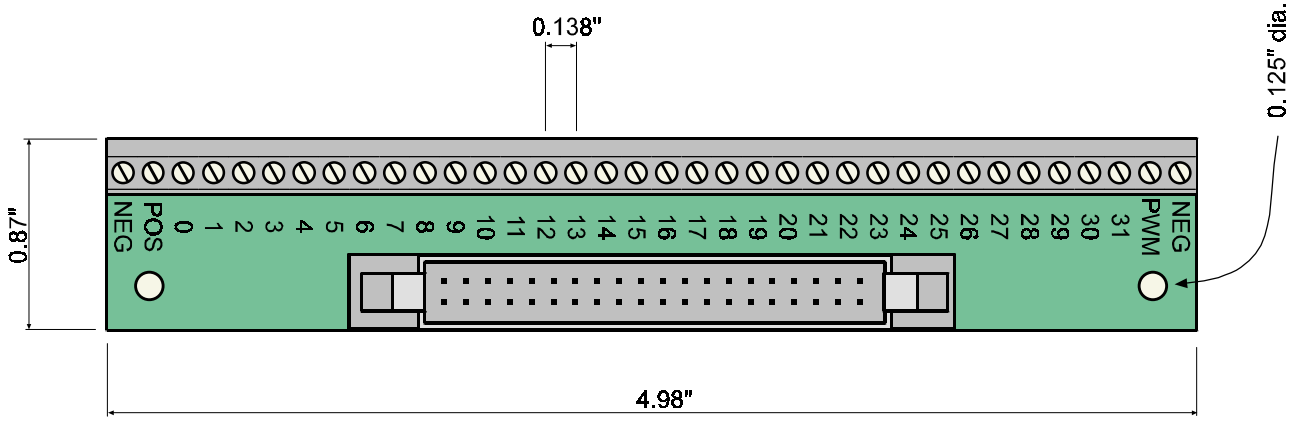
The negative of the power supply must connect to "NEG"; in most cases this is also ground of the system. We recommend that all NEG pins connect to the power supply. If you are using our optional screw terminal blocks *TERM1-128* or *TERM1-64*, the NEG pins are already brought together to a single terminal. Make sure that this wire is big enough to handle the current of all the solenoids that may be on at any one time.

No "clamping" diodes are necessary for most installations, the UM0 contains an active clamp on each output; the active clamp turns itself on at 50 to 60 volts, causing a faster turn-off than regular clamping diodes.

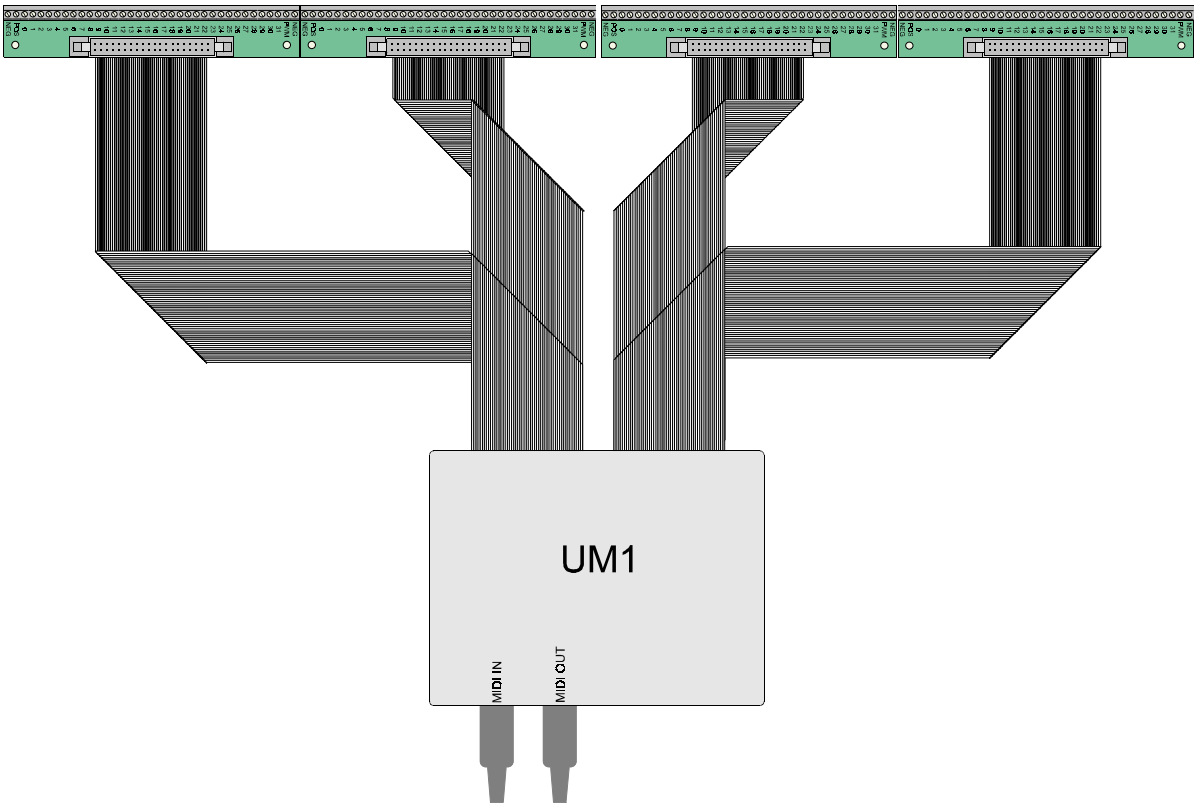
Vibrato output:
The vibrato output is a slow oscillator whose frequency is controlled from zero to 10 pulses per second, by MIDI Modulation Bender messages (see page 12). This output can be used to control a door or device that modulates the sound.

## Connecting with screw terminal blocks

Wiring is simplified with our optional screw terminal blocks *TERM1-128* or *TERM1-64*, (or solder terminal blocks *TERM1-S-128* or *TERM1-S-64*), which bring out all the input/outputs where they can connected directly to your wires.




The diagram below shows screw terminals for 128 outputs, connected to a UM0.



# Operation

Apply power to the UM0. If it is setup as relay driver, send it MIDI note messages and the corresponding outputs should turn on and off. If it is setup as a keyboard encoder, press keys and watch for MIDI note messages coming out. If it's not working as planned, see troubleshooting, below.

## Installing the UM0 software

To install the *UM0 setup/diagnostics software* on your PC, insert the diskette and run the file called "setup".

## Software setup / diagnostics

The UM0 can be configured with the *UM0 setup/diagnostics software*.
Connect the UM0's MIDI IN to the PC's MIDI OUT and the UM0's MIDI OUT to the PC's MIDI IN (actually, several UM0's can be chained together as in the diagram page 4. You may be able to change the setup without removing the units from your installation).
Power up the UM0, and run the *UM0 setup/diagnostics software*.
The software will attempt to find the UM0(s) on your MIDI port, and will give you the choice between setup or diagnostics; just follow the instructions.

# Troubleshooting

The UM0 does not have the display making it more difficult to troubleshoot.

## General problems

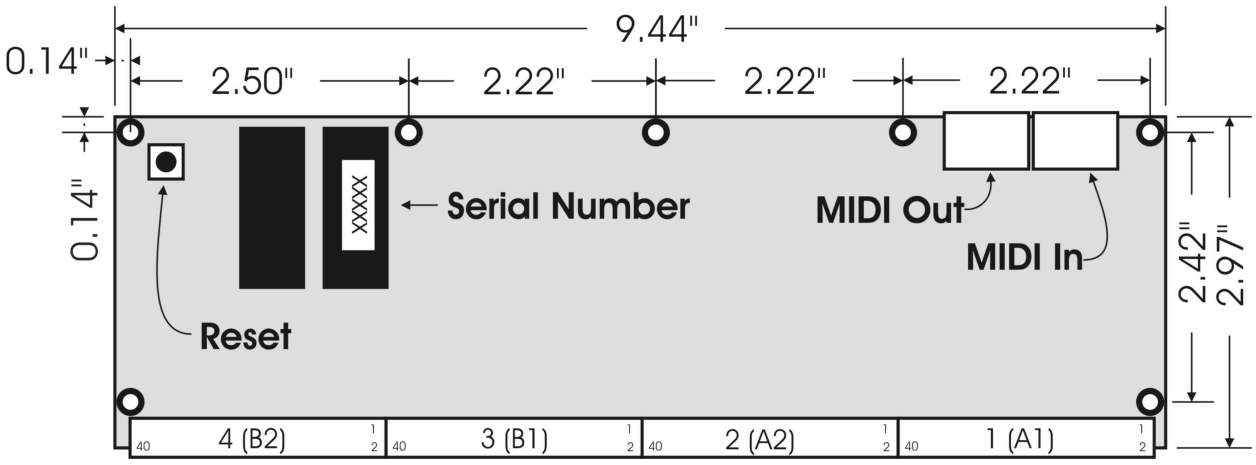
| Symptom | Probable cause | Solution |
|---|---|---|
| Nothing works, the *UM0 software* can't find the unit | No power | Make sure you apply a positive voltage of 7 to 25 volts between pin 1 (POS) of any of the 40 pin headers to any NEG pin. |
| | Cables | Connect the UM0's MIDI IN to the PC's MIDI OUT and the UM0's MIDI OUT to the PC's MIDI IN. Test your PC's MIDI port with a synthesizer if possible |
| UM0 sometimes gets/sends the wrong note, or ignores some notes | MIDI cable interference | Try a shorter MIDI cable or one of superior quality, fully shielded. |
| | Electro-magnetic interference | Move the UM0 away from motors, high current cables, high current relays/switches, CB radios. |
| You have run the *UM0 software* successfully, but the UM1-BB is not working correctly | | Use the charts below |

## UM0 as relay driver

| Symptom | Probable cause | Solution |
|---|---|---|
| Sending MIDI messages to the UM0 does not activate its outputs | Wrong MIDI channel | The MIDI channel of the source should match that of the UM0. If you have two partitions, the number displayed is the channel of partition A; partition B may have a different channel, according to the software setup (see page 7) |
| | Wrong connector | MIDI OUT of the source should connect to MIDI IN of the UM0. |
| | No MIDI coming through cable | Check your MIDI source by connecting a sound module or synthesizer, if you have one |
| | Wrong mode of operation | Check the mode of operation with software setup (see page 7). The partition(s) must be setup as output |
| | Notes out of range | Depending on the mode of operation, you may call for transposition. Without transposition, the first output is MIDI note zero.<br>Notes out of range do not activate outputs. |
| | Output polarity | The UM0's outputs switch to the negative side of the power supply, so the other side of the relay (or light or voltmeter) should be connected to the positive of the power supply. |
| One output does not respond | Bad relay | Check that relay, swap it for a known good one |
| | Short | Check wiring of this Output |

**Note:** Make sure the wire going to the common side of the solenoids to the "+" side of the power supply and the wire from the "Neg" side of the UM0 to the "-" side of the power supply is large enough to supply all the current necessary to activate the maximum number of solenoids that may be on at any one time.

# Mechanical specifications




# Electrical specifications

| Parameter | Min. | Max. | Units |
|---|---|---|---|
| Storage temperature | -40 | 100 | °C |
| Operating temperature | 0 | 50 | °C |
| Humidity (non-condensing) | 0 | 95 | % |

## Power supply

The power for the UM0's internal circuits is provided at the 40-pin headers. The same power input is used for the programmable pullup resistors; usually it is also the power supply of the user's external circuits.

| Parameter | Min. | Max. | Units | Notes |
|---|---|---|---|---|
| Supply voltage | 7 | 25 | Volts | |
| Supply current | | 0.2 | Amp | no load |

## Driver Outputs (standard)

The 128 open collector driver outputs are provided at the 40-pin headers.
(The output drives low for a key on command).
Active clamps enable driving solenoids or relays directly.

| Parameter | Typ. | Max. | Units | Notes |
|---|---|---|---|---|
| On output voltage | 0.2 | 0.3 | Volts | at 50mA load |
| On output voltage | 0.5 | 0.6 | Volts | at 100mA load |
| On output voltage | 1.3 | 2.0 | Volts | at 250mA load |
| Switching time | 200 | | nsec | |
| duty cycle | | 100 | % | all outputs at 120mA load |
| duty cycle | | 30 | % | all outputs at 250mA load |
| duty cycle | | 100 | % | 2 of 8 outputs at 250mA * |

## Driver Outputs of UM0-P (double power option)

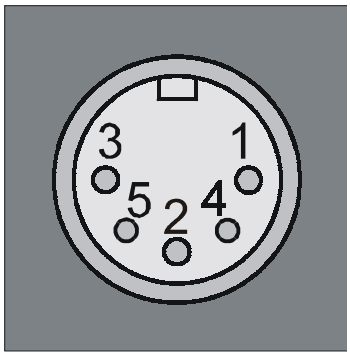
| Parameter | Typ. | Max. | Units | Notes |
|---|---|---|---|---|
| On output voltage | 0.1 | 0.2 | Volts | at 100mA load |
| On output voltage | 0.3 | 0.5 | Volts | at 250mA load |
| On output voltage | 0.7 | 1.0 | Volts | at 500mA load |
| duty cycle | | 100 | % | all outputs at 250mA load |
| duty cycle | | 40 | % | all outputs at 500mA load |
| duty cycle | | 100 | % | 2 of 8 outputs at 500mA * |

* note: 2 outputs of every group of 8 consecutive outputs, as follows: 0-7, 8-15, 16-23, 24-31, 32-39, 40-47, 48-55, 56-63, 64-71, 72-79, 80-87, 88-95, 96-103, 104-111, 112-119, 120-127.

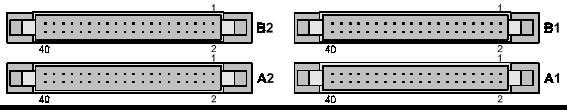
## MIDI connectors

| Pin # | MIDI IN | MIDI OUT |
|---|---|---|
| 1 | NO CONNECT | NO CONNECT |
| 2 | SHIELD | SHIELD |
| 3 | NO CONNECT | NO CONNECT |
| 4 | MIDI IN + | MIDI OUT + |
| 5 | MIDI IN - | MIDI OUT - |

Note: SHIELD is connected to ground through a 0.1µF capacitor, to avoid ground loop currents.



# Input/Output connectors




| Pin # | Connector 1 (A1) | Connector 2 (A2) | Connector 3 (B1) | Connector 4 (B2) |
|---|---|---|---|---|
| 1 | POS | POS | POS | POS |
| 2 | INPUT/OUTPUT 0 | INPUT/OUTPUT 32 | INPUT/OUTPUT 64 | INPUT/OUTPUT 96 |
| 3 | INPUT/OUTPUT 1 | INPUT/OUTPUT 33 | INPUT/OUTPUT 65 | INPUT/OUTPUT 97 |
| 4 | INPUT/OUTPUT 2 | INPUT/OUTPUT 34 | INPUT/OUTPUT 66 | INPUT/OUTPUT 98 |
| 5 | INPUT/OUTPUT 3 | INPUT/OUTPUT 35 | INPUT/OUTPUT 67 | INPUT/OUTPUT 99 |
| 6 | INPUT/OUTPUT 4 | INPUT/OUTPUT 36 | INPUT/OUTPUT 68 | INPUT/OUTPUT 100 |
| 7 | INPUT/OUTPUT 5 | INPUT/OUTPUT 37 | INPUT/OUTPUT 69 | INPUT/OUTPUT 101 |
| 8 | INPUT/OUTPUT 6 | INPUT/OUTPUT 38 | INPUT/OUTPUT 70 | INPUT/OUTPUT 102 |
| 9 | INPUT/OUTPUT 7 | INPUT/OUTPUT 39 | INPUT/OUTPUT 71 | INPUT/OUTPUT 103 |
| 10 | NEG | NEG | NEG | NEG |
| 11 | INPUT/OUTPUT 8 | INPUT/OUTPUT 40 | INPUT/OUTPUT 72 | INPUT/OUTPUT 104 |
| 12 | INPUT/OUTPUT 9 | INPUT/OUTPUT 41 | INPUT/OUTPUT 73 | INPUT/OUTPUT 105 |
| 13 | INPUT/OUTPUT 10 | INPUT/OUTPUT 42 | INPUT/OUTPUT 74 | INPUT/OUTPUT 106 |
| 14 | INPUT/OUTPUT 11 | INPUT/OUTPUT 43 | INPUT/OUTPUT 75 | INPUT/OUTPUT 107 |
| 15 | INPUT/OUTPUT 12 | INPUT/OUTPUT 44 | INPUT/OUTPUT 76 | INPUT/OUTPUT 108 |
| 16 | INPUT/OUTPUT 13 | INPUT/OUTPUT 45 | INPUT/OUTPUT 77 | INPUT/OUTPUT 109 |
| 17 | INPUT/OUTPUT 14 | INPUT/OUTPUT 46 | INPUT/OUTPUT 78 | INPUT/OUTPUT 110 |
| 18 | INPUT/OUTPUT 15 | INPUT/OUTPUT 47 | INPUT/OUTPUT 79 | INPUT/OUTPUT 111 |
| 19 | NEG | NEG | NEG | NEG |
| 20 | INPUT/OUTPUT 16 | INPUT/OUTPUT 48 | INPUT/OUTPUT 80 | INPUT/OUTPUT 112 |
| 21 | INPUT/OUTPUT 17 | INPUT/OUTPUT 49 | INPUT/OUTPUT 81 | INPUT/OUTPUT 113 |
| 22 | INPUT/OUTPUT 18 | INPUT/OUTPUT 50 | INPUT/OUTPUT 82 | INPUT/OUTPUT 114 |
| 23 | INPUT/OUTPUT 19 | INPUT/OUTPUT 51 | INPUT/OUTPUT 83 | INPUT/OUTPUT 115 |
| 24 | INPUT/OUTPUT 20 | INPUT/OUTPUT 52 | INPUT/OUTPUT 84 | INPUT/OUTPUT 116 |
| 25 | INPUT/OUTPUT 21 | INPUT/OUTPUT 53 | INPUT/OUTPUT 85 | INPUT/OUTPUT 117 |
| 26 | INPUT/OUTPUT 22 | INPUT/OUTPUT 54 | INPUT/OUTPUT 86 | INPUT/OUTPUT 118 |
| 27 | INPUT/OUTPUT 23 | INPUT/OUTPUT 55 | INPUT/OUTPUT 87 | INPUT/OUTPUT 119 |
| 28 | NEG | NEG | NEG | NEG |
| 29 | INPUT/OUTPUT 24 | INPUT/OUTPUT 56 | INPUT/OUTPUT 88 | INPUT/OUTPUT 120 |
| 30 | INPUT/OUTPUT 25 | INPUT/OUTPUT 57 | INPUT/OUTPUT 89 | INPUT/OUTPUT 121 |
| 31 | INPUT/OUTPUT 26 | INPUT/OUTPUT 58 | INPUT/OUTPUT 90 | INPUT/OUTPUT 122 |
| 32 | INPUT/OUTPUT 27 | INPUT/OUTPUT 59 | INPUT/OUTPUT 91 | INPUT/OUTPUT 123 |
| 33 | INPUT/OUTPUT 28 | INPUT/OUTPUT 60 | INPUT/OUTPUT 92 | INPUT/OUTPUT 124 |
| 34 | INPUT/OUTPUT 29 | INPUT/OUTPUT 61 | INPUT/OUTPUT 93 | INPUT/OUTPUT 125 |
| 35 | INPUT/OUTPUT 30 | INPUT/OUTPUT 62 | INPUT/OUTPUT 94 | INPUT/OUTPUT 126 |
| 36 | INPUT/OUTPUT 31 | INPUT/OUTPUT 63 | INPUT/OUTPUT 95 | INPUT/OUTPUT 127 |
| 37 | NEG | NEG | NEG | NEG |
| 38 | NO CONNECT | NO CONNECT | NO CONNECT | NO CONNECT |
| 39 | VIBRATO (PWM1) | RESERVED | RESERVED | RESERVED |
| 40 | NEG | NEG | NEG | NEG |

NEG is the negative of the power supply; in most cases this is also ground of the system. As an output device, the UM0 switches its outputs to NEG; we recommend that all NEG pins connect to the power supply.
POS is the positive of the power supply (7-25 volts) for the UM0; usually, this is also the common to all the relays or switches in the system. At least one connection to POS is required.

# MIDI note chart

| Octave | C | C# | D | D# | E | F | F# | G | G# | A | A# | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 2 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 |
| 3 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
| 4 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| 5 | **60** | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| 6 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 |
| 7 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 |
| 8 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 |
| 9 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 |
| 10 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | | | | |

Shaded notes are the standard 61 note keyboard range.
Additional shaded notes are the standard 88 piano keyboard range.

Note **60** is middle C of keyboard

# MIDI commands

Note: MIDI data numbers are hexadecimal.
k is channel number 0-F; 0 is channel 1, F is channel 16

**Channel voice messages:**

| Bytes | Description |
|---|---|
| 8k nn vv | Note Off event, running status accepted |
| 9k nn vv | Note On event (vv = 0:Note Off) running status accepted |
| Ek vv vv | Pitch bend change (lsb first) NOT IMPLEMENTED |

**Channel Mode Messages:**

| Bytes | Description |
|---|---|
| Bk 7B 00 | All Note Off event |
| Bk 01 vv | Modulation Bender (Vibrato), zero is Off |
| Bk 40 vv | Sustain pedal, zero is Off, otherwise On |

**System Real-Time Messages:**

| Bytes | Description |
|---|---|
| FF | Reset system to power-up status. (including all notes Off) |
| FE | Active Sensing.<br>Use of this message is optional. When initially sent, the receiver will expect to receive MIDI messages or another Active Sensing message at least every 300ms, or it will be assume that the connection has been terminated. At termination, the receiver will turn off all voices and return to normal (non-active sensing) operation. |

# System exclusives (advanced users):

The following are commands to output binary data to all outputs or to retrieve binary data from all inputs. Note that because sysex data are 7bit bytes, our 8 bit bytes are each split into 2 bytes: the first contains 7 most significant bits, the second contains the remaining bit.

### Dump Request (from host to UM0)

| Byte | Description |
|---|---|
| F0 7E kk | Exclusive Non-Realtime Header kk = channel of partition A |
| 03 00 | |
| pp | pp = 1 all 128 inputs<br>pp = 2 partition A 64 outputs (use this for UM1-64)<br>pp = 3 partition B 64 inputs |
| F7 | EOX |

Note: the UM0 responds with a Dump data message.

### Dump Data (from UM0 to host)

| Byte | Description |
|---|---|
| F0 7E kk | Exclusive Non-Realtime Header kk = channel of partition A |
| 02 00 | |
| pp | pp = 1 all 128 inputs<br>pp = 2 partition A 64 inputs<br>pp = 3 partition B 64 inputs |
| | dd .. dd<br>all outputs data: 32 bytes data (16 pairs, left justified: 7 bits 1st byte, 1 bit 2nd byte)<br>partition A or B: 16 bytes data (8 pairs: 7 bits 1st byte, 1 bit 2nd byte) |
| F7 | EOX |

Note: response from above request: the UM1 reads its inputs and sends that data.

### Dump Data (from host to UM0)

| Byte | Description |
|---|---|
| F0 7E kk | Exclusive Non-Realtime Header kk = channel of partition A |
| 02 00 | |
| pp | pp = 5 all 128 outputs<br>pp = 6 partition A 64 outputs (use this for UM1-64)<br>pp = 7 partition B 64 outputs |
| dd .. dd | all outputs data: 32 bytes data (16 pairs, left justified: 7 bits 1st byte, 1 bit 2nd byte)<br>partition A or B: 16 bytes data (8 pairs: 7 bits 1st byte, 1 bit 2nd byte) |
| F7 | EOX |

Note: The UM0 loads in this data and transfers it all at once to its outputs.

# Ordering information

| | |
|---|---|
| UM0 | standard product with 128 outputs bare board |
| UM0-P | double power UM0-128 |
| TERM1-128, TERM1-64 | screw terminal set for 128 outputs, 64 outputs |
| TERM1-S-128, TERM1-S-64 | solder terminal set for 128 outputs, 64 outputs |

# Warranty

MIDIator Systems warrants for two years from the date of purchase this product if it does not perform satisfactorily due to defects caused by faulty materials or workmanship. Our obligation assumed under this warranty is limited to the repair, replacement or refund of this product, if it has not been misused.

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MIDIator Systems accepts no responsibility for damages resulting from the use of this product and make no warranty or representation, either express or implied, including but not limited to, any implied warranty of merchantability or fitness for a particular purpose.
The product owner's sole and exclusive remedy against MIDIator Systems shall be, at MIDIator Systems' sole discretion, for (A) repair or replacement of defective product; or (B) repayment of the price paid for the product. No other remedy (including, but not limited to, incidental or consequential damages or lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available to owner. In no event shall MIDIator Systems' liability exceed amount paid for the product.

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